

Determination of Lead and Cadmium in Soil Samples of Bharatpur City of Rajasthan State

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ABSTRACT

The place was ruled by an tribal community of Sinsinwar clan, who came to India in 100 AD. Gohad city was built in 1505 AD and developed as a famous Jat state which was later ruled by the Marathas. In 1733 AD, Maharaja Suraj Mal built the city of Bharatpur. It is believed that it was a well-fortified city under his rule. Bharatpur was carved out from Mewat and got its name from Lord Bharat (Lord Rama's brother). Bharatpur, also known as 'Eastern Gate of Rajasthan', is located in the Braj region 180 km away from Delhi. Geographically, the district is situated between 26° 22' and 27° 83' N and 76° 53' and 78° 17' E and its average height above sea level is around 183 m. Bharatpur city is the district headquarters and is also known by the name of Lohagarh. It is situated very close to the main cities of Rajasthan and other states. Distance between Jaipur and Bharatpur is around 178 km whereas Agra lies at a distance of 55 km from the district. Mathura is located at a distance of 34 km. Bharatpur touches Gurgaon of Haryana in the north, Mathura in the east, Agra of Uttar Pradesh and Dholpur of Rajasthan in the south and Dausa and Alwar in the west. There are only three main seasonal rivers in this District, namely Ban Ganga, Rooparel and Gambhir. Ban Ganga starts from Ramgarh Dam of Jaipur district, passes from Bharatpur and meets in river Gambhir near tehsil Bayana of District Bharatpur. Gambhir river starts from Panchna Dam of district Karauli and after passing from Bharatpur meets River Yamuna in Uttar Pradesh. Rooparel River starts from hills of district Alwar and enters into Bharatpur from tehsil Kaman. Instead of this, a Dam, namely, Bandh Baretha is situated near the village Baretha on river Kakund which starts from the hills of district Karauli. The water of this dam is used for drinking and irrigation purpose for this district. The capacity of this dam is 684.00 million cubic feet (29 Gaze feet).

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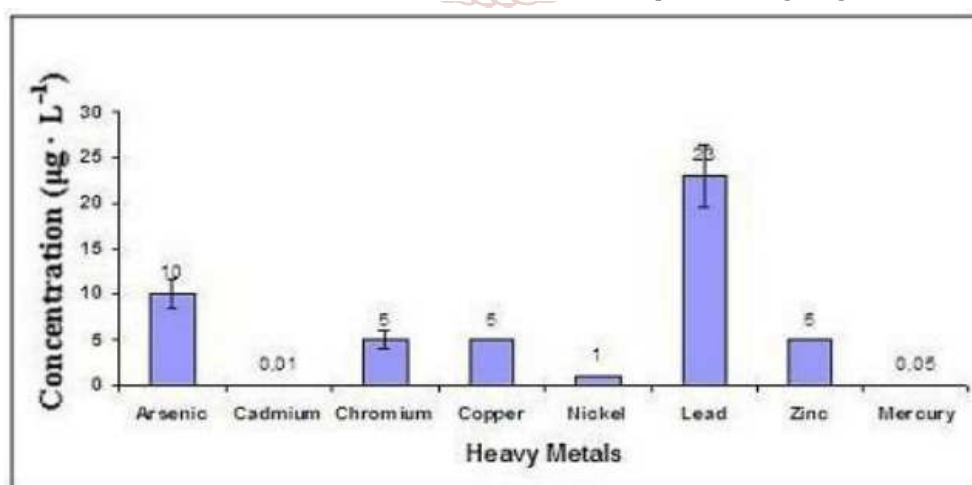
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KEYWORDS: Bharatpur, Rajasthan, lead, cadmium, soil samples, Karauli, water, dam

INTRODUCTION

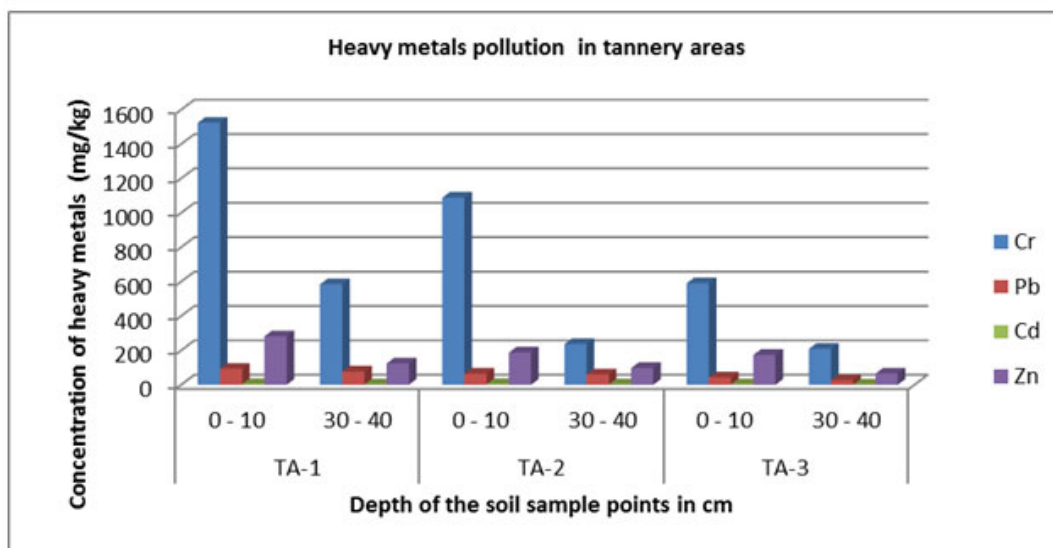
The soil in the state of Rajasthan is divided into seven different types. The fertility of the soil improves from west and northwest side towards the east and northeast side. Alluvial soil is one out of the seven different types. It is found in Alwar, Bharatpur, Jaipur and Sawai Madhopur and the central part of Ganganagar district. ¹



Heavy metals (note lead and cadmium) in water near soil samples in Bharatpur, Rajasthan

All these districts lie in the northeastern part of Rajasthan. metal toxicity in soil samples of different areas of Bharatpur, Rajasthan was recorded. The maximum amount of metal was of lead and cadmium. There are two major sources of heavy metal pollution: natural and anthropogenic activities². However, anthropogenic activities like mining, refining, waste disposal due to increased industrialization and urbanization leads to increased rate of exposure to such metals in human. Due to their non-biodegradable and persistent nature, continuous exposure to metals give rise to a constant threat to mankind. Lead is a known

highly toxic metal present ubiquitously in environment. Due to its versatile physical and chemical properties, it has been widely found in soil of Bharatpur³. The main route of exposure is via inhalation and ingestion through water and food. Children are more susceptible to lead toxicity as compared to adults due to increased hand to mouth activity. Lead exposure may lead to devastating health effects ranging from subclinical to life threatening complications. Acute toxicity may result in headache, hypertension, abdominal pain, sleeplessness, fatigue, renal dysfunction, arthritis, while chronic exposure results in dyslexia, psychosis, muscular weakness, kidney damage, intellectual disability and even death. Cadmium is also a well-known toxicant which is widely distributed in the environment. Due to its non-corrosive property, it has been used in various industries in Bharatpur, Rajasthan. ⁴



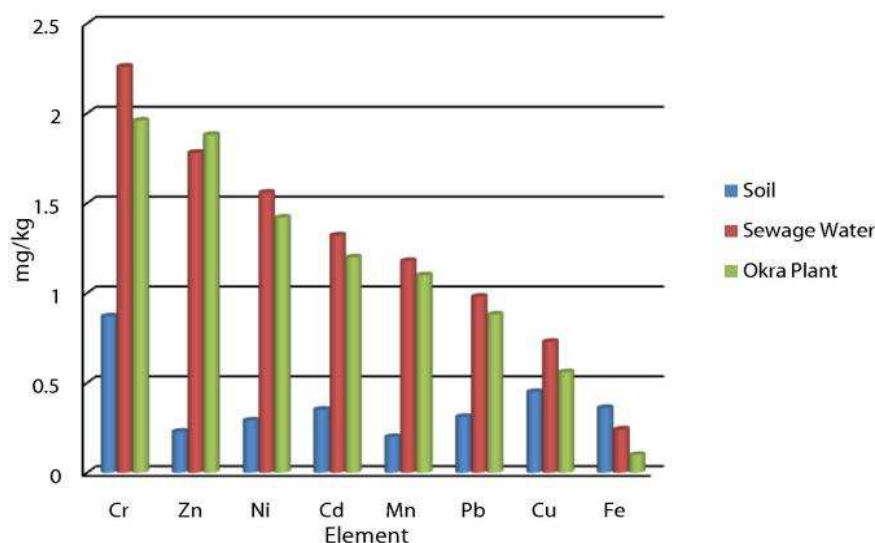
Heavy metals (specifically lead and cadmium) in soils of tannery areas of Bharatpur, Rajasthan

It is also mostly found in soil of Bharatpur. Cadmium is mainly absorbed by inhalation and ingestion. Apart from occupational exposure, cigarette smoke is the most common source of cadmium exposure. Acute exposure may lead to gastrointestinal disturbances like nausea, vomiting, abdominal cramps and diarrhea and chills, muscle aches. Long term exposure may result in respiratory manifestations like bronchial and pulmonary irritation, pneumonitis, emphysema, renal effects: increased urinary excretion of low-molecular-weight proteins, affect glomerular function, bone effects: osteoporosis and osteomalacia.⁵Rajasthan has several industrial areas and few studies that have examined the presence of heavy metals in and around these areas, have found high levels of lead, cadmium, zinc, copper, mercury, iron. these findings suggest high level of occupational heavy metal exposure in people working in these regions.⁶In this context, the present study was planned to find out the levels of lead and cadmium in soil samples of Bharatpur, in Rajasthan, India. The study aimed at facilitating awareness among workers about the risk of heavy metal toxicity due to their exposure to such metals in their work environment and helping them by providing the guidelines and measures to be taken to minimize the exposure.⁷

Discussion

Lead and cadmium are the most important occupational pollutants in today’s environment. Moreover, lack of enforced legislation, public awareness, and education makes individuals easily prone to metal exposure.⁸

Heavy Metals Concentration



Field accumulation risks of heavy metals (Lead and cadmium basically) in soils of Bharatpur, Rajasthan

Occupational exposure to heavy metals has not been investigated in workers of Bharatpur, Rajasthan. To the best of our knowledge this is the first study to assess the blood lead and cadmium levels of occupationally heavy metal exposed workers in

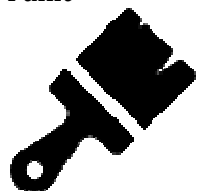
Bharatpur, Rajasthan.³⁶ The present study highlights the difference in the blood lead and cadmium levels of the individuals working in various industrial setups and the non-exposed subjects. To the best of our knowledge, it is the first study to assess the metal levels in occupationally metal exposed workers of Bharatpur, Rajasthan.⁹ Exposure to cadmium and lead may pose deleterious effects on the health of the workers. Measures should be taken to reduce such exposures. Workers should be given proper information about the toxic effects and complications that may result from continuous exposure to such metals at their workplace. Appropriate preventive measures like use of protective clothing, gloves, masks, education on personal hygiene, and preventive strategies should be adopted to promote prevention and reduction of exposure to such heavy metals. Occupational safety and health act should be mandated and strict enforcement of such policies should be ensured in industrial areas to ensure safety of the workers.¹⁰

Results

In soil samples of Bharatpur, Rajasthan, lead is a naturally occurring metal. Its chemical and physical characteristics, such as its malleability, low melting point and resistance to corrosion, making it amenable to a range of uses.¹¹ Lead is also highly toxic to humans and the environment, it is a cumulative toxicant particularly hazardous to young children and pregnant women.³⁵ No safe level of lead exposure has been established. Once taken into the body, lead can cause permanent damage to the neurological and cardiovascular systems. The main lead exposure and absorption route are inhalation, ingestion and dermal contact. Inhalation of fumes and dust is a major exposure route for people working with lead. Young children are particularly likely to be exposed through contaminated soil and air-borne household dust because they spend a lot of time in one place playing on the ground with frequent hand-to-mouth activity. Lead exposure can result in learning disabilities, increased risk of antisocial behavior, reduced fertility and cardiovascular disease.¹²

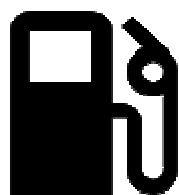
Uses of lead:-

Paint



Lead compound can add durability, opacity and color to paint. As of September 2019, 73 countries have adopted lead paint law to reduce the amount of lead added in paint to 90 ppm, the smallest quantity technically feasible. In 2009, the Global Alliance to Eliminate Lead Paint was established. It aims to catalyze efforts to prevent children's exposure to lead from paints and to minimize occupational exposures to lead paint. Together with WHO, UNEP acts as co-secretariat and the US EPA is the chair of the Lead Paint Alliance.³⁴

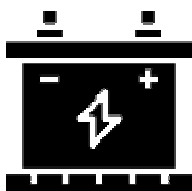
Petrol



Historically, tetraethyl lead was added to petrol as an antiknock agent for better engine combustion. Through its uses, lead was dispersed on surface soils, resulting in the most significant historical source of human lead exposure.³³

Since 2002 UNEP supports the Partnership for Clean Fuels and Vehicles (PCFV), the leading global public-private initiative promoting cleaner fuels and vehicles in developing and transition countries, throughout its successful 10 years campaign to end the use of leaded petrol on a global scale.¹³

Lead-Acid Batteries



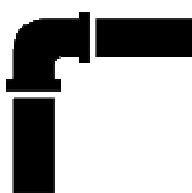
Batteries account for more than 80% of the global demand of lead. Improper recycling of used lead-acid batteries causes environmental pollution and health damage. The largest subsets of lead-acid batteries are for automotive applications³². With increasing numbers of cars in use globally, this market will continue to expand. Lead-acid batteries are also required for industrial applications, to ensure consistent energy for telecommunications and data networks, for example. Since 2016, UNEP has been supporting efforts worldwide to promote the environmentally sound management of used lead-acid batteries.¹⁴

Cookware and food storage



Lead has been identified in vessels used for cooking and food storage, from which it can transfer to food.³¹ Lead is incorporated into glazes and colorful decorations used on the surface of traditional pottery. In addition to ceramics, lead can be found in metal cookware. In many low- and middle-income countries, locally-made aluminum cookware is common. Informal artisans use scrap metal from products such as waste engine parts, vehicle radiators, lead batteries and computer parts to make the cookware, incorporating whatever metals, including lead, in the final product.¹⁵

Construction and Plumbing



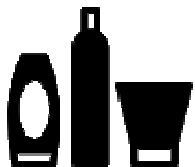
Since the Roman times, Lead has been widely used as a material in water distribution pipes, fittings and solder in homes and central distribution networks. With no effort to universally replace these components, many remain in use today³⁰. Lead piping is less likely to be installed in water distribution systems today because of the public health risk and the availability of alternatives, but some are still used in the chemicals industry. Other constructions still use remain of lead in sheeting, radiation shielding, roofing and flashing.¹⁶

Food



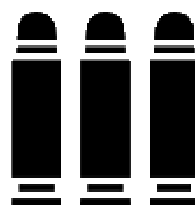
In addition to the ability of lead to end up in food through cookware or containers, lead has been added intentionally to food to enhance the color or sweetness of the product. In some countries, lead can also be found in high concentration as an adulterant in spices.¹⁷

Cosmetics and dyes



Certain forms of lead are known to enhance color when included as additives. One sector of products in which lead may be found for pigmentation is cosmetics and dyes. One of the most widely used products containing lead is kohl. It can also be found in products such as eye shadows or hair dye products.¹⁸

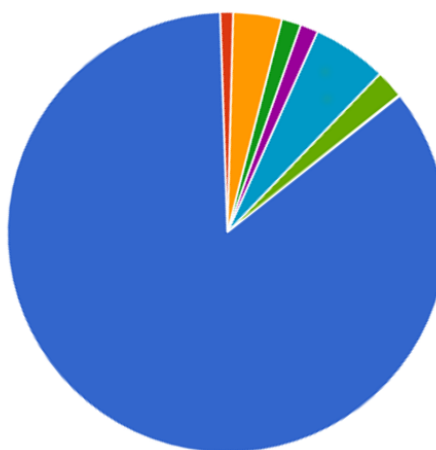
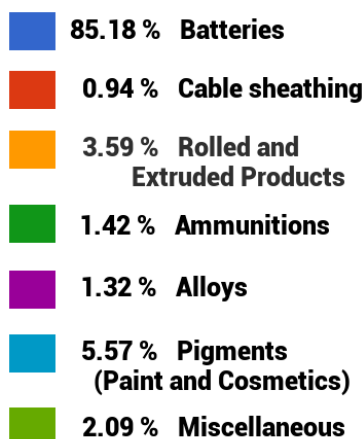
Fishing and ammunition



Despite regulatory actions in some countries, lead-based ammunition and fishing weights remain significant sources of lead in the environment, impacting both wildlife and human health through the food chain. For both of these applications, lead is an attractive material because of its high density, malleability and low cost.²⁸

The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA) and the Convention on Migratory Species (CMS) - two international environment treaties behind World Migratory Bird Day - are also driving international efforts to tackle the global lead poisoning threat.¹⁹

Principal uses of Lead worldwide



Utilities of Cadmium

Cadmium is a non-essential and toxic element for humans mainly affecting kidneys and the skeleton. It is also a carcinogen by inhalation. Cadmium is accumulated in bone and may serve as a source of exposure later in life. Cadmium is used in batteries, paints, plastics, electroplating etc. It is released to the atmospheric environment from metals production, fossil fuel combustion. Phosphorous fertilisers and sewage sludges are also a major source of environmental releases of cadmium.²⁰

Cadmium and fertilizer

Cadmium is a non-nutritive metal considered harmful to the environment and to humans, affecting mainly kidney and the skeleton and It is also carcinogen by inhalation. This heavy metal is used in batteries, paints, plastics, electroplating etc. It is released to the atmospheric environment from metals production, fossil fuel combustion. Cadmium is naturally present in the earth's crust and oceans but can also be added to the soil through natural and anthropogenic activities such as irrigation waters, manure, and fertilizers derived from phosphate rock. When the latter are mined, they can release cadmium concentrations of as much as 300mg/kg once they are used in the soil as fertilizers. Cadmium is considered a class one carcinogen by the World Health Organization (WHO).²¹

The presence of cadmium in the environment, increased by activities such as years of coal and fossil-fuel usage and mining is a serious health hazard and its monitoring is essential. The accumulation of cadmium in the soil through the usage of fertilizers can affect crops and ultimately animals and humans²⁷. Its known accumulation in the food chain has the potential for causing chronic diseases of the

renal, pulmonary, cardiovascular and musculoskeletal systems. The WHO and the Food and Agriculture Organization (FAO) have agreed on and implemented safe exposure levels for food in the Codex Alimentarius and the European Food Safety Association is also enforcing a reduction of cadmium exposure since it is becoming increasingly dangerous for certain subpopulations who are exposed to it the most.²²

Cadmium has been a concern for the EU since the 1970s, due to its toxic nature. Despite most levels of cadmium in anthropogenic sources are regulated, their level in fertilizers remains uncontrolled in across the EU. In 2016, the Fertilizer Regulation (EC) No 2003/2003 was revised and proposed, with two main goals. The first one was to allow the free movement of all fertilizers, including recycled and mineral fertilizers.²⁶ The revision also aimed to increasingly adhere to environmental standards in order to minimize negative effects on human health and the environment. Another important component of the regulation was to limit cadmium in fertilizers, which currently does not have any restriction, to first a limit of 60mg/kg P205, lowered at 40mg after three years and ultimately to 20mg after 12 years. The European Parliament adopted the proposal but lengthened the time frame to 16 years instead of the initial 12. The US also established environmental standards for this heavy metal, according to the Environmental Protection Agency (EPA) the ceiling for the amount of cadmium that can be applied to land is 85 mg/kg fill material. Since 2001, UNEP has been mandated to address the environmental and health risk of lead and cadmium, upon advice from the working group on lead and cadmium.²³

Conclusions

In summary, previous studies have shown that exposure to lead or cadmium is associated with subclinical arteriosclerosis and endothelial damage. Although we have known these two heavy metals have been shown to negatively affect lipid metabolism, and some lipoprotein biomarkers have been linked to an increased risk of CVDs, there has not yet been a study that specifically examines the role of lipid profiles in the relationship between these heavy metals and arteriosclerosis.²⁵ In addition, the relationship between these heavy metals and novel lipoprotein biomarkers has not yet been explored. Furthermore, as humans are often exposed to both lead and cadmium simultaneously, it would be valuable to investigate the effects of co-exposure on lipoprotein profiles and arteriosclerosis due to their presence in soil which get into water and are drunk without purification by the rural people nearby Bharatpur in Rajasthan²⁴

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